

EMERGENCY SUPPORT

Tim Drum
Carolina Power & Light

OVERVIEW OF CP&L

Carolina Power & Light Company provides electric power to over 966,000 customers in North Carolina and South Carolina. Headquartered in Raleigh, North Carolina, we serve about 3.5 million people in a 30,000 square-mile territory. A map of our service area is provided in Figure 1. We operate a flexible mix of fossil, nuclear, and hydroelectric resources with a total generating capacity of 9,654 megawatts. CP&L's strategic geographic location facilitates purchases and sales of power with many other electric utilities, allowing us to serve our customers more economically and reliably. The region's favorable business environment supports a diverse industrial base. Major industries we serve include textiles, chemicals, metals, paper, and electric machinery and equipment.

CP&L operates four nuclear units at three plant sites. Figure 1 shows the geographical locations of these plants. The H. B. Robinson Plant (RNP in Figure 1) is a 665 megawatt pressurized water reactor site that was completed in 1971. The Brunswick Steam Electric Plant (BNP in Figure 1) has two 790 megawatt boiling water reactor units that were completed between 1975 and 1977. The Shearon Harris Plant (HNP in Figure 1) is a 900 megawatt pressurized water reactor that was completed in 1986.

ORGANIZATIONAL STRUCTURE

CP&L made a decision in the mid 1970's to centralize its meteorological functions into one geographical and organizational entity. All Company business related to meteorology flows through the Environmental Services Section (ESS). An organizational chart for the ESS is shown in Figure 2. The Air Permits and Meteorology Unit (AP&MU) responsibilities range from providing nuclear meteorological support (including nuclear emergency preparedness) to providing severe weather forecasting for distribution and transmission line crew management. Specific unit functions and responsibilities are outlined in Table 1. The Air Quality Monitoring and Compliance Unit (AQM&CU) has the primary responsibility of operating and maintaining the nuclear meteorological stations and the air quality monitoring sites.

REGULATORY BACKGROUND

The roots of the nuclear meteorological program can be traced to the Nuclear Regulatory Commission (NRC), Regulatory Guide 1.23 (RG 1.23). This guide was originally designed to implement

Paragraph 100.10(c)(2) of 10 CFR Part 100, "Reactor Site Criteria," which states that, in determining the acceptability of a site for a power or test reactor, the NRC will take into consideration meteorological conditions at the site and surrounding area.

In addition to the requirements for determining meteorological conditions at nuclear power plants in order to assess siting, licensing, and environmental factors, detailed meteorological information is necessary for dealing with radiological emergencies. Paragraph 50.47 of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and Appendix E, "Emergency Plans for Production and Utilization Facilities," to 10 CFR Part 50 require power plant licensees to provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. In this regard, it is necessary for the licensee to establish and maintain a meteorological program capable of rapidly providing meteorological information to assess and monitor actual or potential consequences of a radiological emergency condition.

Pursuant to 10 CFR Part 50 a plethora of guidelines were issued by the NRC in order to direct licensees on how to specifically comply with providing reasonable assurances that adequate protective measures were in place in the event of a radiological emergency. Primary documents related to meteorological aspects of emergency preparedness include NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Appendix 2, Meteorological Criteria for Emergency Preparedness at Operating Nuclear Power Plants; NUREG-0696, "Functional Criteria for Emergency Response Facilities"; RG-1.97 (Rev. 2), "Instrumentation for Light-Water Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident"; and Supplement 1 to NUREG-737, "Requirements for Emergency Response Capability." The purpose of Supplement 1 to NUREG-737 was to incorporate into one document all fundamental requirements for nuclear plant emergency response capability from the wide range of guidance documents that the NRC had issued and to provide additional clarifications on some specific items. One such area of clarification was meteorology. NUREG-0654, Appendix 2 had specified elaborate meteorological systems and sophisticated dispersion models (i.e., Class A and Class B models). Supplement 1 to NUREG-737 superseded the meteorological requirements of NUREG-0654, Appendix 2 by stating that only meteorological variables specified in RG 1.97 (Rev. 2) (i.e., wind speed, wind direction, and atmospheric stability) are required. However, a dispersion modeling capability was still required but was left to the licensee to determine what would meet 10 CFR Part 50. The basic tone of Supplement 1 to NUREG-737 was to change the interpretation of existing NUREGs and RGs from a strict requirement to one of simply guidance.

THE CP&L APPROACH

In order to meet the above NRC guidelines, CP&L has instrumented towers at each of its nuclear plant sites. No backup towers are used. Reasoning for this configuration will be discussed shortly. Table 2 shows details of the parameters measured at the plant meteorological sites. Figure 3 is a flowchart of the meteorological data path from sensor to display and storage. The box labeled, ERFIS, in the lower right-hand side of Figure 3 is the Emergency Response Facilities Information System. This is a computer system that contains all of the plant Safety Parameter Display System (SPDS) displays. Also notice that there is a dedicated telephone link to the General Office. This is used by the Corporate meteorological staff to verify system operability and data validation before meteorological data is released for use in making dose projections by the plant emergency response personnel in the Technical Support Center (TSC) and the Emergency Operations Facility (EOF).

CP&L also operates a weather center in the corporate headquarters in Raleigh, North Carolina. The center is staffed by meteorologists and normally operates on a 7:00 a.m. to 6:00 p.m., Monday through Friday, schedule. However, a staffing plan for 24 hours per day, seven days per week, operations in support of radiological emergencies and severe weather events is in effect. In addition to meteorological data from the Company's three nuclear plant sites, synoptic meteorological data originating from the National Weather Service (NWS) is available. Specific NWS products available in the Weather Center include digital facsimile weather maps (DIFAX), alphanumeric data, weather radar imagery, satellite imagery, lightning data via the National Lightning Detection Network (NLDN), and other derived meteorological products.

The weather center concept was developed to meet the intent of 10 CFR Part 50 requirements of providing reasonable assurances to adequately provide meteorological information to assess and monitor consequences of a radiological emergency. In the unlikely event of the loss of on-site meteorological data, dispersion conditions surrounding the plant site can be determined by the Company's professional meteorological staff using data readily available in the weather center. Micrometeorological forecasts of dispersion conditions for up to five days are also available for making time-integrated and ingestion pathway dose projections. This configuration negates the need for backup meteorological towers at the Company's nuclear plant sites. We have found that this is a very cost-effective approach, particularly when the additional benefits of the weather center concept are included. For example, in addition to support of nuclear emergency preparedness the weather center and meteorological staff provide meteorological forecasts for short-term load control and long-term load forecasting, historical and statistical meteorological data services, and severe weather forecasts for critical distribution and transmission line crew management decisions.

DIRECT EMERGENCY PREPAREDNESS SUPPORT

Direct meteorological nuclear emergency preparedness support consists of two phases: emergency drill scenario development and emergency drill participation. Meteorological data routinely developed for a drill depends on whether the meteorological conditions during the drill will be "real" or "predetermined." "Real" means that the actual meteorological conditions during the drill time frame and micrometeorological forecasts based on real-time data will be used for the drill. "Predetermined" means that the meteorological conditions and the forecasts for the drill are based on data that has been manufactured prior to the drill. Most of the drills that CP&L conduct use predetermined meteorological data. There are both advantages and disadvantages to each approach. The main advantage to using predetermined data is that it allows much more control of the drill. Usually, each drill has specific goals and objectives. For example, one goal may be to test evacuation of a media center. Using predetermined data would allow one to force the atmospheric conditions that would require the evacuation action. However, only the use of real data allows the weather center staff to utilize and maintain the necessary skills needed for making micrometeorological forecasts. Consequently, we have developed an internal training plan within the AP&MU which consists of periodic internal simulated drills for each of our three plant sites once per year.

Two forms have been developed by CP&L to communicate meteorological data from the weather center to the TSC and the EOF. Figure 4 displays an example of an On-site Meteorological Data Form. This is used for either developing the predetermined data for a drill or for logging the actual data when real data is used. Two hours of 15-minute data can be displayed on one page. Information from this form is transmitted to the TSC and EOF every 15 minutes. Figure 5 shows an example of the Meteorological Forecast Form. This form includes a one-hour forecast, a three-hour forecast and space for any necessary remarks. This form is issued to the TSC and EOF every hour during a drill. Both forms can be transmitted via a computer modem link, by fax, or the information can be transmitted verbally via the telephone.

We continue to strive to make the meteorological portions of the drill scenarios as challenging as possible. This is accomplished by periodically including certain severe weather elements into the scenarios. For example, hurricanes affecting our coastal and near coastal sites are sometimes worked into the scenarios during the autumn months. The potential of severe thunderstorms and tornadoes are sometimes included in the scenarios during the spring and summer months. Scenarios with rain or snow cause particularly challenging conditions in handling wet deposition. Plant sites located in complex terrain such as mountainous areas or coastal locations can have unique meteorological situations. For example, we are currently in the process of completing a Sea Breeze Project at our Brunswick Plant located about five miles inland from the Atlantic Ocean. The purpose of the project is to develop meteorological criteria for making a determination under what conditions a sea breeze would

form and to develop prognostic tools for determining the inland extent of the sea breeze front and the slope of the associated thermal internal boundary layer. Therefore, sea breeze situations are sometimes part of the meteorological scenarios at our Brunswick Plant.

DOSE PROJECTIONS

The ultimate purpose of a meteorological program in support of nuclear emergency preparedness is to accurately characterize atmospheric conditions to be used as input for the purpose of making dose projections. The dose projections are usually accomplished by use of numerical modeling. The models usually consist of four parts: source term, atmospheric transport and diffusion, dose, and output. The atmospheric transport and diffusion aspects will be the focus of the remainder of this paper. CP&L is structured such that the meteorological staff of the AP&MU have the ultimate responsibility for the atmospheric transport and diffusion part of the dose projection model.

Currently CP&L is using a model developed in-house. The transport and diffusion part is patterned after NRC RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," and the "Workbook of Atmospheric Dispersion Estimates", by Bruce Turner, U.S. EPA. This is a simple straight-line Gaussian dispersion model that runs on a personal computer.

As part of the continuing emphasis on emergency preparedness, the NRC sponsored the development of a rapid dose assessment system by Pacific Northwest Laboratory (PNL). This system, the Interactive Rapid Dose Assessment Model (IRDAM), is a micro-computer based program for rapidly assessing the radiological impact of accidents at nuclear power plants. IRDAM was implemented by the NRC in 1982 for use by the NRC staff. The atmospheric diffusion portion of IRDAM also incorporates the basic straight-line Gaussian equations similar to NRC RG 1.145.

In 1989 the NRC began using RASCAL, the Radiological Assessment System for Consequence Analysis. This system replaced the IRDAM system. Atmospheric transport and diffusion is modeled using both Lagrangian puff and Gaussian plume models. Diffusion assumptions are the same as those recommended in NRC RG 1.145 and Turner's workbook. In RASCAL, however, the atmosphere is divided into three layers. The top layer of the model includes the entire atmosphere above the top of the mixed layer (usually above 1000 m). The middle layer includes the mixed layer down to 10 m above the ground. The bottom layer is from the ground surface to 10 m above it. However, the meteorological conditions do not vary with location or height. Only one meteorological station is allowed. No corrections are made for terrain effects. RASCAL only allows ground level and elevated release modes. No mixed-mode releases are allowed. However, the model does incorporate algorithms for wet and dry deposition.

The NRC cautions that results obtained from other models (other than RASCAL) should be compared with RASCAL results not from the standpoint that RASCAL is the correct method, but with the intent of understanding what differences exist between models and how those differences will impact projected doses. CP&L has compared its in-house developed model with the parts of RASCAL that are similar and found that, in certain modes, the CP&L model compares favorably, within a factor of 3.3 or less. Generally a factor of two could be expected under ideal conditions, and generally a factor of ten 10 can be expected under typical meteorological conditions.

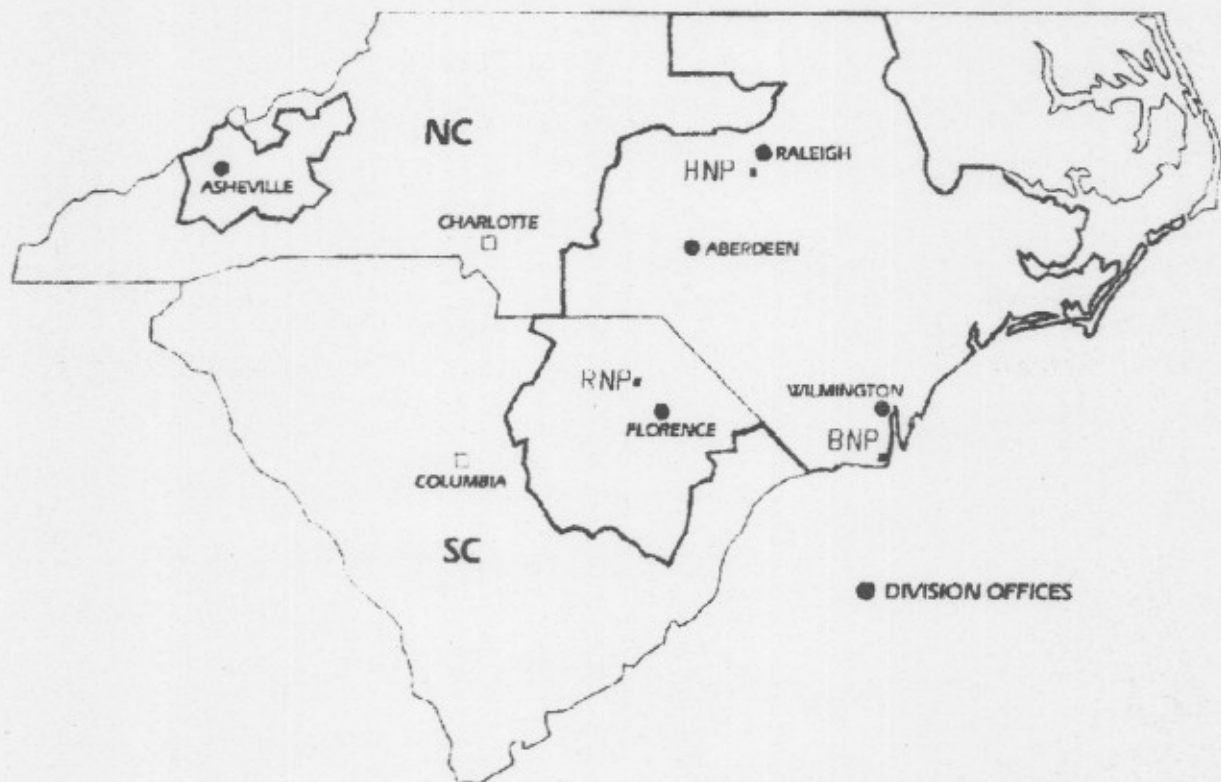
SUMMARY

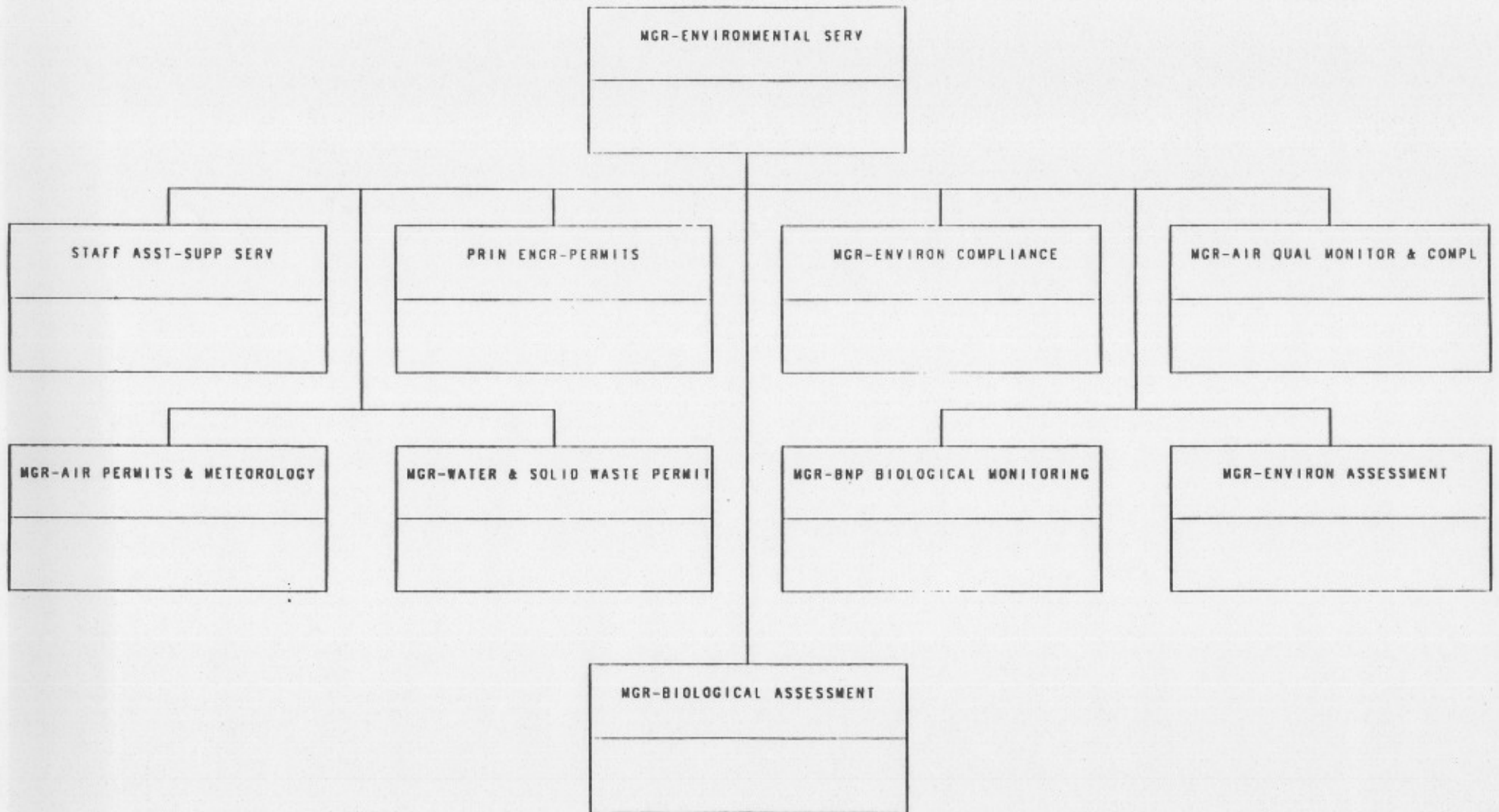
This paper has focused on the approach that CP&L has implemented to support meteorological aspects of nuclear emergency preparedness. Emphasis has been placed on the organizational structure, drill scenario development, drill participation, dose projection, and the regulatory background that has formed the basis of emergency preparedness support. Also, the weather center concept and the centralization of meteorological functions into one geographical and organizational entity has been discussed.

CP&L has found this approach to be very cost effective. However, I recognize that this is not the only approach available and that my hope is that fact will become apparent in the panel discussion that will follow. Therefore, the intent of this paper has been not to define the correct methodology but to provide a background to encourage communication to foster new and better ideas.

FIGURE 1

CP&L SERVICE AREA





HNPD METEOROLOGICAL DATA FLOWCHART

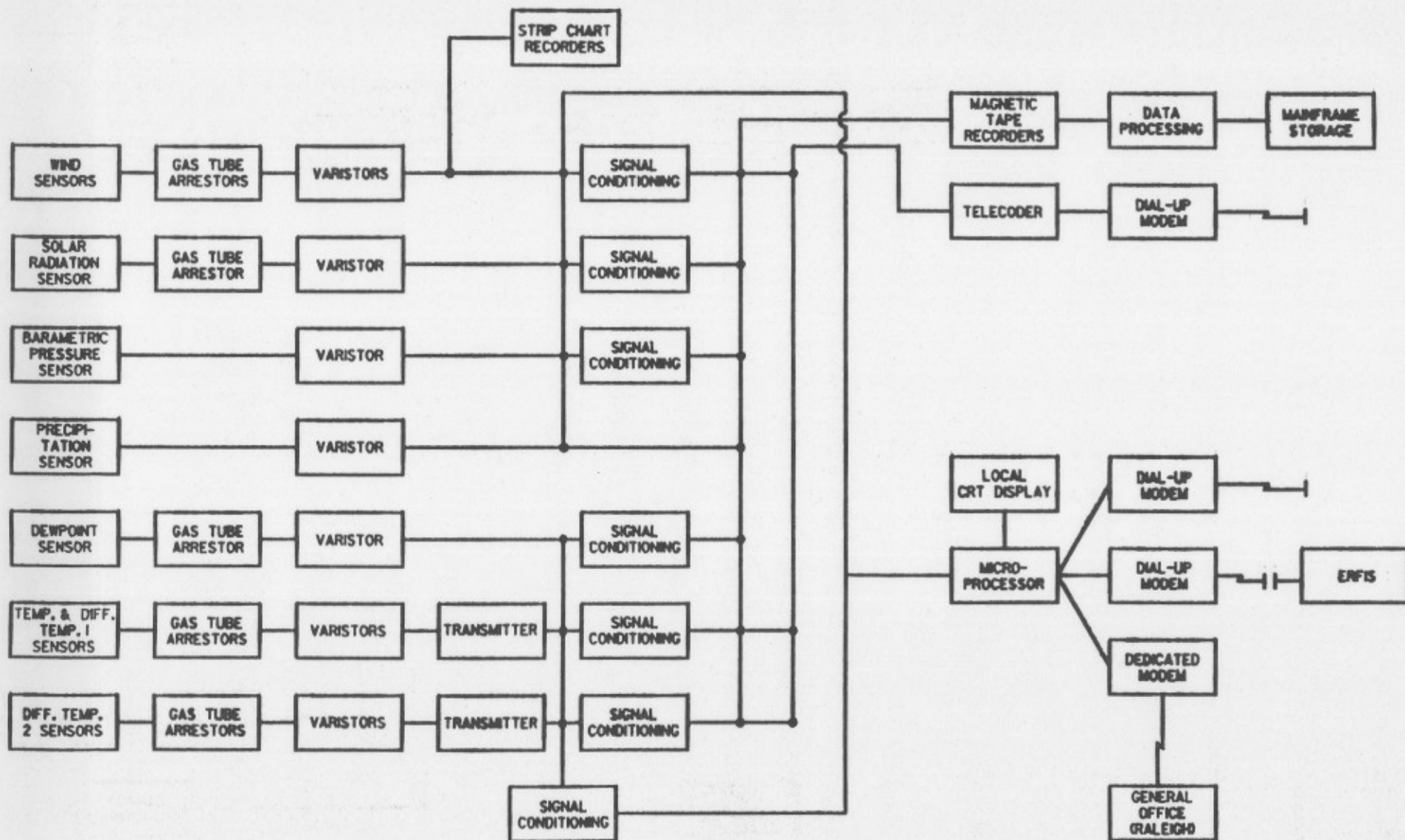


FIGURE 4

CP&L

Carolina Power & Light Company ONSITE METEOROLOGICAL DATA

Date: September 10, 1991Plant: Harris

Time (EDT)	<u>15:00</u>	<u>15:15</u>	<u>15:30</u>	<u>15:45</u>
Upper Speed (mph)	<u>9.2</u>	<u>9.3</u>	<u>10.0</u>	<u>9.1</u>
Upper Direc. (DEG)	<u>138</u>	<u>140</u>	<u>141</u>	<u>141</u>
Lower Speed (mph)	<u>4.7</u>	<u>5.2</u>	<u>4.1</u>	<u>4.3</u>
Lower Direc. (DEG)	<u>47</u>	<u>46</u>	<u>43</u>	<u>40</u>
AMB Temp. (°F)	<u>74.2</u>	<u>74.4</u>	<u>74.6</u>	<u>74.6</u>
ΔT (°C/100m)	<u>-1.30</u>	<u>-1.41</u>	<u>-1.42</u>	<u>-1.38</u>
Stability Class	<u>D</u>	<u>D</u>	<u>D</u>	<u>D</u>

Time (EDT)	<u>16:00</u>	<u>16:15</u>	<u>16:30</u>	<u>16:45</u>
Upper Speed (mph)	<u>8.3</u>	<u>9.1</u>	<u>9.3</u>	<u>8.1</u>
Upper Direc. (DEG)	<u>138</u>	<u>133</u>	<u>146</u>	<u>141</u>
Lower Speed (mph)	<u>5.3</u>	<u>5.1</u>	<u>4.3</u>	<u>3.8</u>
Lower Direc. (DEG)	<u>45</u>	<u>58</u>	<u>49</u>	<u>52</u>
AMB Temp. (°F)	<u>74.7</u>	<u>74.6</u>	<u>74.4</u>	<u>74.3</u>
ΔT (°C/100m)	<u>-1.20</u>	<u>-1.32</u>	<u>-1.30</u>	<u>-1.31</u>
Stability Class	<u>D</u>	<u>D</u>	<u>D</u>	<u>D</u>

CP&L

Carolina Power & Light Company

METEOROLOGICAL FORECAST FORM

Date: September 10, 1991Time Issued: 18:00 EDT

Issued By: _____

Received By: _____

Forecast Location: Harris

A) Next 1 Hour

- 1) Wind Direction: Sector ENE Deg. 65°
- 2) Winds Should Remain (Steady; Shifting; Variable)
2a) Variation Should Be ±20 Deg.
- 3) Wind Velocity: 4 to 6 (MPH)
- 4) Stability Class D
- 5) Precipitation Activity Will Be (None, Scattered, Steady)
- 6) Precipitation Type (Rain, Rainshowers, Thunderstorms, Ice, Snow)
- 7) Precipitation Intensity (Light, Moderate, Severe)

B) Next 3 Hours:

Winds: SE 4-6 MPH

Precipitation: NONE

Stability Class: D

C) Remarks: _____

TABLE 1

UNIT FUNCTIONS AND RESPONSIBILITIES

Provide meteorological support for Emergency Preparedness at BNP, RNP, and HNP.

Provide weather forecasting for Nuclear and Fossil Operations, Customer Support, and Skaale Energy Center.

Review and comment on proposed federal and state air quality regulations.

Review and provide interpretation on final regulations related to air quality.

Obtain and maintain all federal, state, and regional air quality permits for Company facilities (includes incinerators and asbestos permits).

Conduct air quality modeling for compliance with standards to support new, amended, or renewed air permits for Company facilities.

Provide technical support for State and Federal Public Affairs in the air quality area.

Meteorological data management.

Provide technical air quality support for plant design, modifications, and operations.

TABLE 2
SHEARON HARRIS PLANT
Lat: 35°38'01" N
Long: 78°57'23" W

AMBTMP = 10m level Ambient Temperature (-50°F to +130°F)
UPWNSPD = 60m level wind speed (0 - 100mph)
UPWNSVAR = 60m level wind direction variance (0° - 45°)
UPWNSDIR = 60m level wind direction (0° - 360°)
LOWNSDIR = 10m level wind direction (0° - 360°)
LOWNSVAR = 10m level wind direction variance (0° - 45°)
LOWNSPD = 10m level wind speed (0 - 100 mph)
DELTAT1/DELTAT2 = Differential Temperature Between 10m - 60m levels
(-10°C/100m to + 15°C/100m)
PRECIP = Precipitation (in.)
BAROPRESS = Atmospheric Station Pressure (28 - 32 in. Hg)
SOLARAD = Total Sky Radiation (0 - 2Ly/min)
DPLICL = 10m level Lithium Chloride Dewpoint Temperature
(-50°F to +100°F)

TABLE 2 (continued)

BRUNSWICK PLANT
Lat: 33°57'30" N
Long: 78°00'30" W

AMBTMP = 10m level Ambient Temperature (-50°F to +130°F)
UPWNDSPD = 100m level wind speed (0 - 100mph)
UPWNDVAR = 100m level wind direction variance (0° - 45°)
UPWNDDIR = 100m level wind direction (0° - 360°)
LOWNDDIR = 10m level wind direction (0° - 360°)
LOWNDVAR = 10m level wind direction variance (0° - 45°)
LOWNDSPD = 10m level wind speed (0 - 100 mph)
DELTAT1/DELTAT2 = Differential Temperature Between 10m - 60m levels
 (-10°C/100m to + 15°C/100m)
PRECIP = Precipitation (in.)
BAROPRESS = Atmospheric Station Pressure (28 - 32 in. Hg)
SOLARAD = Total Sky Radiation (0 - 2Ly/min)
DPLICL = 10m level Lithium Chloride Dewpoint Temperature
 (-50°F to +100°F)

TABLE 2 (continued)

ROBINSON PLANT

Lat: 34°24'02" N

Long: 80°09'05" W

AMBTEMP = 10m level Ambient Temperature (-50°F to +130°F)

UPWNDSPD = 60m level wind speed (0 - 100mph)

UPWNDVAR = 60m level wind direction variance (0° - 45°)

UPWNDDIR = 60m level wind direction (0° - 360°)

LOWNDDIR = 10m level wind direction (0° - 360°)

LOWNDVAR = 10m level wind direction variance (0° - 45°)

LOWNDSPD = 10m level wind speed (0 - 100 mph)

DELTAT1/DELTAT2 = Differential Temperature Between 10m - 60m levels
(-10°C/100m to + 15°C/100m)

PRECIP = Precipitation (in.)

BAROPRESS = Atmospheric Station Pressure (28 - 32 in. Hg)

SOLARAD = Total Sky Radiation (0 - 2Ly/min)

DPLICL = 10m level Lithium Chloride Dewpoint Temperature
(-50°F to +100°F)